SYSTEM FOR THE AUTOMATIC APPLICATION OF SELF-ADHESIVE PROTECTIVE FILM TO VEHICLE BODIES

[0001] The invention relates to a system for the automatic application of self-adhesive protective film to vehicle bodies according to the preamble of claim 1, as emerges as disclosed, for example, from DE 198 09 515 A1, which in the following text is cited as [1] for short.

[0002] It is primarily the horizontal body parts - three in conventional sedans - namely the hood, roof and rear panel, which are to be protected by having an appropriate piece of a self-adhesive protective film stuck over them for the transport of the new vehicle from the fabrication site to the vehicle dealer. The system disclosed by [1] for the application of the protective transport film intrinsically represents a small production line comprising a plurality of workstations. Therein, the finally assembled vehicles standing on their own wheels and to be stuck are conveyed cyclically through the various stations of the application system; during an application of a piece of protective film, the vehicles are temporarily stopped.

[0003] In order to be able to understand the present invention correctly, it is necessary to assume correct understanding of the mode of operation of the application system disclosed by [1], for which reason this system is to be discussed in more detail first.

[0004] In a first workstation of the application system according to [1], the supply rolls of the protective film are arranged to be stationary and centrally above the conveyor line with the roll axis located transversely with respect to the transport direction; the film is therefore drawn off the supply rolls in the transport direction. In this case, for each of the three aforementioned body parts, a separate supply roll is provided in each case, whose width measured in the axial direction corresponds to the length of the associated body part measured in the body longitudinal direction. Each of the three supply rolls is arranged at a different height, so that a piece of film can be drawn off from each of the three rolls as required. The supply rolls are in each case dimensioned to be sufficiently large that they contain the film needed for at least one working shift.

[0005] In the known application system, in the drawing-off direction beside each of the supply rolls, in each case an appropriate piece of film is held stationary and stretched out horizontally by two suction strips at a distance, this piece of film not yet having been cut off the supply roll. The adhesive side of this piece of film points downward. Perforation lines are made in this stretched-out piece of film by means of a heated cutting tool by a first working robot in an accurate contour and in a defined position from the non-adhesive upper side. Regions of the protective film that are not needed can later be removed along these perforation lines. The three pairs of stationary suction strips each stretching out a piece of film - just like the supply rolls as well - are arranged in the vertical direction at such a vertical distance from one another that the working robot drawing the perforation lines can reach without hindrance with its working tool between two pieces of film stretched out one above the other.

[0006] Parallel beside each of the front suction strips facing away from the respective supply roll, in each case there is arranged a cutting bar having a cutting knife that can be moved therein, with which a piece of film drawn off for further processing and already provided with perforation lines can be cut off the supply. Furthermore, in each of the suction strips stretching out the piece of film, at the ends, that is to say both on the right and left in each case, there are arranged mechanical holding tongs that can be opened and closed mechanically, which reach around the film at the side edges on the upper and underside with their tong snout. These holding tongs hold the film temporarily, for example during the transfer to a suction strip of another working robot, or stretch out the film in the transverse direction after a drawing-off operation, in order that the film can then be picked up by the suction strips of the unwind station again without any defects or creases.

[0007] The pieces of film held stretched out and provided with a perforation line are picked up by a first application robot for the purpose of further processing, said robot being provided with a suction strip at the wrist of its working arm. This first robot is set up laterally beside the conveying line of the vehicles and can move in the longitudinal direction between unwind station and application station. During the film transfer to the application robot, first of all the two

holding tongs of the front suction strip on the unwind side close and hold the stretched-out piece of film at its front end firmly at the side edges and stretch out the film in the transverse direction; at the same time, the suction strip on the unwind side releases its hold on the piece of film and moves laterally by at least the placement width in order to create space for the suction strip of the aforementioned application robot, which is placed there and picks up the piece of film. The rear suction strip of the unwind station close to the roll is then vented, so that the perforated piece of film is still stretched out only between the supply roll and the suction strip of the application robot. The latter then draws a predetermined length of film horizontally off the supply roll, whereupon the suction strip of a second application robot is placed on the rear end of the piece of film that is drawn off, that is to say beside the aforementioned cutting bar, said robot being arranged on the opposite side of the vehicle conveying line and picking up the rear end of the piece of film drawn off. The front suction strip on the unwind side is then also moved into its working position directly beside the cutting bar again and both suction strips on the unwind side are activated. Thus, the film drawn off is held firstly by the two stationary suction strips of the unwind station and by the suction strips of the two opposite application robots. The piece of film held by the application robots is then separated from the stationary, stretched-out piece of film by means of the knife bar, and the two application robots move the piece of film held by them into the application station, pivoting the piece of film initially stretched out in the longitudinal direction transversely with respect to the conveying direction of the vehicles with a mutually synchronously coordinated movement. In this orientation of the piece of film picked up by the application robots, it can be aligned over the associated body part, brought close vertically and applied.

[0008] Since, in most cases, as stated, three horizontal body parts have to have protective film stuck over them, the procedure outlined has to be repeated three times, namely with the appropriate piece of film in each case on each of the three body parts of a vehicle. These application procedures to be carried out three times could be carried out one after another with a time offset by the same pair of opposed application robots, which would lead to a relatively long cycle time. In order to shorten the cycle time, the application system according to document [1] accordingly proposes two pairs of opposed application robots which operate approximately

simultaneously; however, the respective piece of film still has to be picked up from the unwind station by the two pairs of robots with a time offset, for reasons of space and for reasons of accessibility. The third body part then has to have its application carried out by one of the two pairs of robots with a time offset in relation to the two first parts of the body to which applications were made simultaneously. In principle, it would also be conceivable to provide three pairs of opposed application robots in the application system, so that all three body parts could have simultaneous applications. However, this would presuppose a further application station for the third pair of robots and a separate, associated unwind station. The space required and the investment for this purpose are obviously not in a tolerable relationship with the gain in productivity, for which reason in [1] only two pairs of robots are provided in the application system.

[0009] The system disclosed by [1] for protective film application therefore has a total of five industrial robots, which must all be capable of movement under computer control parallel to the conveying direction of the vehicles to be treated, to a certain extent as a seventh robot axis. The cycle time of the protective film application is determined by the time required for two application procedures to be carried out with a time offset, each of which comprises drawing a perforated piece of film from the unwind station, re-orienting this piece of film in the transverse direction, aligning it with the associated body part, and the actual application of the piece of film. In the case of the simultaneous processing of two pieces of film, with regard to the time required it is also necessary to take into account the fact that the "fetching" of the two pieces of film from the unwind station can be carried out only with a time offset, for reasons of accessibility. Despite the relatively high investment for the application system, the productivity is therefore not particularly high.

[0010] Added to this is the fact that, because of the stationary and very high mounting of the heavy supply rolls, these cannot be lifted into the unwind station by using conventional industrial trucks. Instead, a separate bridge crane system has to be provided for the roll change in the application system, which increases the investment. Incidentally, the very heavy supply rolls must not be transported or stored horizontally, since they can acquire flat points as a result,

which would interfere during processing and would impair the protective function locally. Instead, the heavy supply rolls must contain separate cores consisting of steel, with which the supply rolls can be handled and can be kept in separate transport frames, likewise consisting of steel, during transport and storage. The relatively expensive cores and transport frames have to be sent back to the film manufacturer for reuse after the supply roll has been used up, which entails costly logistical effort.

[0011] It is an object of the invention to improve the application system on which the generic type is based with regard to lower investment costs with a simultaneous increase in productivity.

[0012] According to the invention, this object is achieved by the characterizing features of claim 1. The solution according to the invention primarily concerns what is known as the system layout of the application system, that is to say features which refer to the system as a whole. The invention is first to be assessed briefly in the following text with regard to lower investment and operating costs and then with regard to the increase in productivity, before an exemplary embodiment is described in detail.

[0013] The cause of saving a substantial part of the investment costs is the supply rolls integrated in the robot tool for each of the pairs of robots. As a result, fetching and careful pivoting of a piece of film from a central, fixed unwind station is avoided and moving the application robots in the transport direction becomes dispensable. As a result of omitting the movement device of the application robots, these become quite considerably less expensive, since the movement devices are large parts to be fabricated with high accuracy and which are very expensive to produce. In addition, the supply rolls are very small and can be installed in magazines close to the ground; dispatch containers can be handled with conventional industrial trucks, for example fork stackers, and individual supply rolls can readily be handled manually. The roll change can be carried out automatically by the application robots, given a suitable construction of the roll magazine and the application tool. The small supply rolls can be provided with inexpensive disposable cores and, because of their low weight, can readily be transported and stored horizontally. To this extent, logistical efforts loading the operating costs

for the monitored return of expensive empty goods are not necessary. Because of the supply rolls integrated into the tools, the likewise quite costly bridge crane system for high loads, which was necessary in the prior art for loading the unwind station arranged high overhead with the heavy supply rolls, is also dispensed with. All in all, the investment and operating costs of the application system according to the invention are considerably lower than in the prior art on which it is based.

[0014] Furthermore, the new application system permits higher productivity, but this is achieved by using a further pair of application robots as compared with the prior art. On account of the use of three pairs of application robots, all three body parts to be treated can be stuck simultaneously, which reduces the cycle time considerably as compared with the prior art. There, three pairs of - movable - application robots are used only at the expense of a further unwind station arranged overhead. Since the supply rolls are arranged decentrally, new pieces of film can be drawn off the rolls simultaneously, which has a beneficial effect on the cycle time. Despite the present readily possible use of a total of six - stationary - industrial robots, there is nevertheless no additional investment expense as compared with the prior art, even if the system illustrated in [1] having a total of five industrial robots is used for the comparison. The one additional - stationary - industrial robot causes far lower investment costs than are saved by omitting other system components required in the prior art. It must certainly be admitted that the cycle time in the application system according to the invention is not determined solely by the application procedures running simultaneously but that the pieces of film also have to be provided with perforation lines within the cycle time, specifically before the application of the pieces of film, which is also carried out by the application robots. Perforation and application are therefore carried out with a time offset within the cycle time, which is determined by the time duration of the two procedures. In this connection, it is necessary to know that the perforation of the stretched-out pieces of film with the operating means proposed by the invention requires only a fraction of the time of the application of the film. Therefore, despite time-offset perforation and application, a shortening of the cycle time as compared with the prior art with two application procedures within one cycle time is nevertheless achieved.

[0015] Expedient refinements of the invention can be gathered from the subclaims. Otherwise, the invention will be explained further below by using an exemplary embodiment illustrated in the drawing, in which:

[0016] Fig. 1 shows an exemplary embodiment of an application system according to the invention in an outline illustration,

[0017] Figs. 2a to 2d show various working phases of the first application station of the system according to figure 1, in each case illustrated in an elevation taken in the plane II-II,

[0018] Fig. 3 shows an enlarged individual illustration of the detail III from figure 2a, specifically of the two interacting application tools of the application robots located opposite each other,

[0019] Fig. 4 shows an enlarged individual illustration of the detail IV from figure 1 as an elevation, specifically the perforation tool and its mounting, a detail from this in turn being illustrated enlarged, and

[0020] Fig. 5 shows a perspective individual illustration of a small supply roll having a disposable core tube consisting of an inexpensive material.

[0021] The exemplary embodiment illustrated shows a system for the automatic application of self-adhesive protective film to the roof 2, the hood 3 and the rear panel 4 of vehicle bodies 1. The system comprises a plurality of workstations arranged one after another, specifically two application stations 9 and 10 equipped with robots and a manual workstation 11. The vehicle bodies to be treated are conveyed through the workstations by means of a horizontal conveyor 8 laid in the shop floor. Said conveyor brings the vehicle bodies to a standstill in each of the workstations, in each case in a defined working position, in order to carry out certain tasks. Arranged on this and the other side of the horizontal conveyor, in each case in pairs and in a mirror-image fashion in relation to each other, are application robots, that is to say industrial

robots 12a, b and 13a, b and 14a, b for the joint handling and application of one piece of film 24 in each case during its processing. The application robots will be discussed in more detail further below. In the application system, supply rolls are also held in a defined position, from which pieces of protective film can be drawn off by the application robots in a specific length and can be cut off. By means of a suitable perforating device, likewise provided in the system, perforation lines can be drawn with accurate contours in a piece of film held stretched out. These devices are also to be discussed in more detail further below.

[0022] The two separate application stations 9, 10 in the system and further features described below are provided, according to the invention, with regard to lower investment costs and a simultaneous increase in productivity. The fact that a total of three pairs of application robots located opposite each other and working together are provided in two application stations means that all three regions of the body to be protected can be stuck simultaneously. In accordance with the distribution, one application station 9 is given one pair (12a, b) and the other - station 10 - is given two pairs (13a, b and 14a, b) of industrial robots arranged opposite each other for the joint handling and application of one piece of film in each case.

[0023] The application station 9 having only one pair of application robots 12a, b is provided for the treatment of the roof area 2 of the body 1, while the application station 10 is provided with two pairs of opposed application robots 13a, b; 14a, b for the application of a piece of film 24 in each case corresponding to the hood area 3 and the rear panel area 4, respectively. The roof area needs the largest piece of film and, accordingly, the largest application tools 18, 19 on the working arm 16 or on the wrist 17 of the robot 12a, b, which in turn requires most space when handling the piece of film 24 to be applied. For this reason, the two roof application robots 12a, b are advantageously arranged on their own in the workstation 9. By contrast, the two other body areas to be protected - hood 3 and rear panel 4 - need substantially smaller pieces of film and the robots accordingly need smaller robot tools 18', 19' and 18'', 19'', respectively, and less room to move. In addition, these body areas are located far away from each other on the body, so that the two pairs of application robots cannot interfere with each other when working. For this reason,

the two pairs of robots 13a, b and 14a, b for the treatment of hood and rear panel are arranged in a common application station - station 10.

[0024] The base element 15 of each application robot 12a, b; 13a, b; 14a, b is arranged in a cost-effective way to be stationary in the respective application station 9, 10, that is to say immovable with respect to the conveying direction of the horizontal conveying device 8. To be specific, each application robot is arranged beside the position of the associated body part 2, 3 or 4 which the robot has to process and which this body part assumes when the body is at a standstill. Moving the robots in the conveying direction, that is to say in the longitudinal direction of the application system, is not necessary in the system layout according to the invention.

[0025] The possibility of using stationary robots is primarily created by the supply rolls 22, 22', 22'' arranged above the vehicle bodies 1 - as seen in outline - being held laterally beside the horizontal conveying device 8 with the roll axis aligned parallel to the conveying direction. What is important here is that the various supply rolls which are in use - in relation to the conveying direction of the horizontal conveyor - are arranged at different points, specifically in each case at the point of the associated application robots 12a, 13a, 14a. The width B, B', B'' of the supply rolls 22, 22', 22'' corresponds to the length L, L', L'' measured in the longitudinal direction of the body of the respective associated body part to be stuck: roof 2, hood 3 or rear panel 4. Because of the transverse arrangement of the film supply close to the robots, the robots do not need to move in the longitudinal direction to an unwind station arranged symmetrically at the ends in the system in order to fetch a piece of film there. Otherwise, the robots can fetch a new piece of film simultaneously in each case, which was not possible in the prior art.

[0026] In one conceivable configuration of the application system, the supply rolls, including associated cutting device, could for example be arranged to be stationary above the respective pair of application robots in such a way that the non-adhesive side of the protective film points downward. In such a case, the robot tools of both application robots would substantially only comprise a suction strip corresponding to the film width. For an application procedure, the robot arranged opposite the supply roll would draw a suitable piece of film off the supply roll, the

appropriate suction strip gripping the film on the visible side pointing downward. The robot arranged on the same side as the supply roll would then pick up the other end of the piece of film, initially still connected to the film supply, likewise on the underside of the film. Finally, the piece of film would be cut off the film supply. Before said piece can be applied to the body, the piece of film would have to be pivoted through 180° about a horizontal transverse axis, so that the adhesive side of the protective film points downward.

[0027] Such a configuration of the system, possible in principle, would certainly be more productive and cost-effective than the application system disclosed by [1] but would still not be cost-optimal, since heavy supply rolls covering the need for a complete working shift and mounted at a great height would still have to be provided. Although, because of the lateral arrangement of the supply rolls, an expensive bridge crane system with a high loadbearing capacity would not be absolutely necessary; instead the rolls could also be lifted into the lateral mountings by means of conventional forklift trucks; for this purpose, the latter would have to be provided with specific equipment for the roll handling. Furthermore, stable and complicated cores consisting of steel, and transport and storage points for the heavy supply rolls would have to be provided and, in the empty state, would have to be returned to the film manufacturer whilst being monitored, that is to say with a great deal of logistical effort.

[0028] In order to avoid this cost, in the exemplary embodiment illustrated the supply rolls 22, 22' and 22'' which are just being used are small and are in each case arranged directly in the associated robot tool 18, 18', 18'' of one of the application robots 12a, 13a, 14a in each case of a robot pair. Arranged in the robot tool arranged on the wrist 17 of its working arm 16 is a holder 30 for a supply roll, which can be fixed by means of a brake 31 against film being drawn off, and also a cutting device 41. The respectively opposite application robot 12b; 13b; 14b of the pairs of robots substantially contains a suction strip 50 as robot tool 19, 19', 19''.

[0029] Of course, for reasons of weight, only relatively small supply rolls can be arranged within the application tool. One supply roll 22, 22', 22'' in each case expediently contains the film required for about 100 to 200 application procedures. In order nevertheless to permit long-

lasting and automatic operation of the application robots, within the working space which can be reached by the working arm 16 of each application robot provided with a supply roll there is arranged a magazine 21, 21', 21'' for a large number of supply rolls 22, 22', 22''. In these roll magazines, the supply rolls are mounted and held in such a way that they can be transferred automatically into the robot tool 18, 18', 18'' of the application robot. Incidentally, each supply roll is provided with a core 23 made of a cheap material, such as hard paperboard or plastic, which can be used as a disposable core and, under certain circumstances, can be disposed of after use, at least if they are damaged. Return transport of satisfactory cores to the film manufacturer for reuse can take place, which would save disposal costs. For example, empty cores could be added from time to time to the delivery vehicles belonging to the film manufacturer for the empty return journey to the film manufacturer. For this purpose, only collection of the good cores is necessary but not monitored circulation of expensive and voluminous components.

[0030] In fig. 3, the two application tools 18 and 19 of the pair of robots 12a, b are illustrated during the interaction in the phase of the start of the transfer of the free end of the film to the suction strip 50 of the application tool 19 of the robot 12b, which working phase is also shown in figure 2a. The application tools 18' and 19' and, respectively, 18'' and 19'' of the robots 13b and 14b are constructed in a completely analogous way; they differ in practice only in the working width of the robot tools, which is matched to the respective width B' and B'' of the supply roll 22' and 22''. The core tube of the supply roll 22 accommodated in the application tool is mounted in two axially opposite roll holders 30 within the tool. The roll holders are guided on carriages 46 such that they can move in the axial direction of the supply roll and are provided with an appropriate displacement drive and with a fixing device; however, the latter are not illustrated by drawing. Rotatably mounted in the roll holders in each case is a plug-in journal, which can be introduced axially into the core tube 23 of the supply roll and pulled out of the latter, it being possible for each plug-in journal to be braced with the core tube such that it is secure against rotation when introduced, so that no relative rotation between core tube and plug-in journal is possible. The supply roll accommodated between the plug-in journals is mounted within the application tool via the plug-in journals such that it can rotate. At least one of the plug-in journals is provided with a fixing device 31, for example in the form of a brake disk on

the journal side and a brake caliper on the frame side, with which the supply roll can be fixed against film being drawn off.

[0031] In order to carry out a roll change, firstly the empty core tube 23 of the old supply roll is thrown off over an appropriate collecting container. To this end, the two carriages 46 of the roll holders, which are otherwise clamped firmly, are released from the carriage guide and the plug-in journals are also released from the core tube; the carriages can then be moved away from each other, the plug-in journals being withdrawn axially from the core tube and releasing the latter. In this "spread" state of the roll holder, a new supply roll can likewise be picked up from the roll magazine 21. A precondition for this is that the supply rolls provided there are fixed and mounted in a defined position, for example in holding channels matched to the shape, so that the ends of the core tubes are freely accessible axially; in addition, a piece of the film must be unwound from the roll and must be laid out freely horizontally. In order to pick up a supply roll from the roll magazine, the application tool with the "spread" roll holder is lowered onto the supply roll to be picked up in such a way that the two axially withdrawn plug-in journals come to lie on this and the other side of the core tube and otherwise exactly coaxially with the latter. The roll holders can than be moved together and the plug-in journals can be countersunk axially into the core tube. The free end of the unwound and laid-out piece of film is picked up by the suction strip 35. After the carriage 46 has been clamped firmly on the guide and the plug-in journals have been fixed in the core tube, the new supply roll is ready for further processing.

[0032] A deflection roller 32 rests on the circumference of the supply roll and is rotatably mounted in a swinging arm 33, so that it is able to follow the supply roll, of which the diameter decreases. The pendulum-mounted swinging arm is in turn urged in the direction of the supply roll by means of a pressure spring 34, so that the deflection roller always rests on the circumference of the supply roll with a certain force. By means of the deflection roller, the point at which the film is drawn off the circumference of the supply roll is fixed at the point of the common line of contact of the two rolls, so that film can be drawn off the supply roll as required without disruption.

[0033] Arranged within the tool 18 is a suction strip 35 which extends over the width of the supply roll and is aligned parallel to the latter, whose underside contacts the non-adhesive upper side of the film in the run of the film drawn off the supply roll and is air-permeable on this side. The suction strip can have a vacuum applied to it as required - in order to hold the film fast - or else vented again - in order to release it. The suction strip is fixed to a carriage 36, which can be displaced on the carriage guide 37 oriented transversely with respect to the supply roll. The carriage is urged by a return spring 44 into a normal position, determined by a stop 45, but from which it can be expelled, as figure 3 shows.

[0034] The suction strip is provided on two opposite ends with a small niche 38 in each case, in which lateral holding tongs 39 are accommodated in each case in the normal position of the suction strip. Each of the two opposed holding tongs has a tong snout which in each case consists of a pair of pin-like jaw tines 40, which can be moved vertically toward each other in mirror-image fashion and are provided with an appropriate movement drive. When closed, the opposed holding tongs can expediently be pulled apart in the transverse direction, that is to say at right angles to the plane of the drawing, in mirror-image fashion, in order to tension the film held firmly in the transverse direction, in order that it does not sag loosely.

[0035] The holding tongs 39 become active in the phase of the transfer of the free end of the film illustrated in figure 3 and in figure 2a, specifically before the suction strip 35 on the roll side of the application tool 18 is vented and the free end of the film is released. After the suction strip 35 has been vented, the end of the film is still held and stretched out laterally only by the two holding tongs. In order to pick up this end of the film, the suction strip 50 of the opposite application tool 19 dips into the application tool 18 on the roll side and, in the process, pushes the inactive suction strip 35 in the direction of the supply roll counter to the force of the return spring 44. As soon as the penetrating suction strip 50 has assumed the space which the suction strip 35 originally occupied, it (50) has vacuum applied to it and therefore picks up the free end of the film, the holding tongs 39 opening and releasing the film. By means of horizontal movement of the suction strip 50 and of the application tool 19 away from the supply roll, which in this phase is released by disengaging the brake 31, a specific piece of film 24 can then be

drawn off the supply roll. The supply roll is then fixed again by the brake, and the suction strip 35 which has returned into the original normal position likewise has vacuum applied to it. Therefore, the piece of film drawn off is held securely between the suction strips 35 and 50 of the two opposed application tools 18 and 19. The piece of film held stretched out in this way and capable of being handled is then perforated - see further below in conjunction with figure 4 - and then applied to the body.

[0036] By using the rectangular pieces of film 24 having rectangular bounding edges, the intention is to stick over body areas whose boundary edges generally represent curved lines. Although sticking over the edge, for example of the roof in the region of the rear window, is not further damaging, this is not desired in the region of the doors or of the windscreen. Therefore, before the application of the pieces of film, certain perforation lines are drawn, in particular in the edge region of the pieces of film, along which lines the unneeded projections can be torn off following the application of the film. For this purpose, the perforating device, already repeatedly mentioned, is provided in the application system. Also expedient is the perforation of intrinsically closed lines, for example in the region of projecting attached parts such as telephone or satellite antennas.

[0037] The device illustrated in figure 4 for the accurate-contour drawing of perforation lines in a piece of film 24 held stretched out comprises a perforating tool 60 which is held stationary by a holder 20 similar to a gallows. The piece of film held stretched out and jointly by the two opposed application robots is moved past the perforating device in accordance with the contour of the desired perforation lines, with mutual contact between film and perforating wheel 64 of the perforating device. Arranged in the perforating tool 60 held stationary is a perforating wheel 64, which is mounted such that it can pivot about a pivot axis 61 arranged at right angles to the plane of the stretched-out piece of film 24 and is provided with a pivoting drive which, in the exemplary embodiment illustrated, is formed by a controlled stepping motor 62 and a flange-mounted reduction gearbox 63. The pivoting drive is integrated into the programmable controller of the associated pair of application robots as a further movement axis.

[0038] In the exemplary embodiment illustrated, the perforating tool 60 is arranged with the pivot axis 61 vertical and the row of perforating teeth 65 pointing downward. Accordingly, during perforation the stretched-out piece of film 24 is moved along underneath the perforating tool in a horizontal attitude - following the contour of the desired perforation lines - in order that the self-adhesive protective film can be perforated from the non-adhesive side located on top. During the perforation of the piece of film 24 held jointly and, if appropriate, handled by the pair of robots, the plane of the perforating wheel 64 is always oriented tangentially with respect to the contour of the desired perforation lines at the current perforation point. In order to be able to perforate the stretched-out protective film with the lowest possible forces, the perforating teeth 65 of the perforating wheel 64 are not only sharpened but also heated above the melting temperature of the plastic film of which the protective film consists. For the purpose of perforation, the perforating wheel roils on the stretched-out film, the heated perforating teeth penetrating into the film to a specific depth without the action of a great force. In order to heat the perforating teeth, heating inductors 66, which heat the ring of teeth inductively during the revolution, are fitted in the fork in which the perforating wheel is mounted.

[0039] The application procedure of the perforated piece of film 24 is illustrated in a number of phases in figures 2b to 2d. According to figure 2b, the piece of film 24 is oriented in the correct position above the associated body part, here the roof 2, and is lowered slowly onto the roof in a horizontal attitude. In the process, the sticky underside of the protective film contacts the slightly arched roof centrally at first, as can be seen from figure 2c. As a result of further slow lowering of the film, the contact area expands progressively from the center toward the edges, which is important for bubble-free application. Toward the end of lowering the film, its side edges are pivoted downward - figure 2d - so that the film is laid on in a bubble-free manner even in the more highly rounded side region of the roof. The application of the pieces of film to the other body parts, specifically to the hood 3 and the rear panel 4, is carried out in an entirely analogous manner.

[0040] Only after the piece of film 24 has been applied to the body is it separated from the supply roll. For this purpose, a beam-like cutting device 41 is integrated into the application tool

18 on the roll side and extends over the entire width B of the supply roll. In said beam, a carriage 43 which carries a cutting knife 42 is guided such that it can move. In the normal case, the latter is countersunk into a slot in the cutting device, the carriage 43 waiting on one side of the cutting device. In order to cut off the film, the cutting knife emerges from the slot and is moved over the width extent of the cutting device as far as the opposite side, the applied piece of film being separated from the film supply.

[0041] The edges of the pieces of protective film located at the front in the direction of travel are also subjected to the slipstream during the journey with the film-protected vehicle and could detach from the body under certain circumstances because of a strong flow around them. In order to avoid this risk, also while maintaining a comparatively low adhesive force of the self-adhesive protective film - which is certainly intended to be able to be released easily from the body surface and without leaving any residue when it is supplied to the vehicle dealer - the front edges of the pieces of protective film are secured by having a self-adhesive strip with a higher adhesion force stuck over them. These edge securing strips, as they are known, can readily be pulled off the body surface again when required, because of their lower width, particularly since they adhere to the protective film to some extent. In order to be able to carry out the application of these edge securing strips automatically as well, a device 51 for applying a narrow self-adhesive edge securing tape is integrated into the robot tools 19', 19'', those having the suction strip 50. By using said robot, the edges of the film located at the front in the direction of travel of the body 1 can be stuck over automatically in the roof region 2 and hood region 3.

[0042] In the downstream workstation 11 of the application system, certain amounts of work are to be carried out manually. In addition, the work carried out automatically is to be monitored and, if necessary, reworked, at least to a small extent. A substantial part of the manual work constitutes tearing off the perforated, unneeded or undesired edge regions. In addition, pressing on the loosely applied films by means of a film squeegee is carried out manually, at least in certain body regions. Furthermore, in the case of concave points, for example in the region of the hood, the applied film is slit there, the cut edges produced as a result are pressed onto the

body and the initially unprotected strip-like surface region which remains has an adhesive strip stuck over it. This work is expediently also carried out manually.